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Policy issues: state of the environment

State of the environment

Report of the Executive Director

Summary

The present report summarizes the key scientific and policy issues emanating from the assessment and early-warning activities of the United Nations Environment Programme (UNEP) that need to be brought to the attention of the United Nations Environment Assembly of the United Nations Environment Programme.

The issues are drawn from the findings of various integrated and thematic assessments conducted at the global and regional levels in response to the UNEP mandate of keeping under review the world environment situation. Other scientific findings have been referenced where appropriate. In particular, the report highlights the findings of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

*UNEP/EA.1/1.

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I. Background

1. The aim of the present report is to provide the United Nations Environment Assembly of the United Nations Environment Programme (UNEP) with an overview of recent scientific assessment findings, focusing on key policy issues at the global and regional levels, in accordance with the core mandate of UNEP to keep the world environmental situation under review.

2. It should be noted that, to inform its deliberations at its first session, the United Nations Environment Assembly will have before it a number of interrelated documents on various initiatives and processes related to the aforementioned core mandate. These include, in particular, the following documents:

(a) Report of the Executive Director on strengthening the science-policy interface (UNEP/EA.1/2/Add.1);

(b) Report of the Executive Director on support structures and processes for keeping the world environment situation under review, including progress on UNEP Live (UNEP/EA.1/4/Add.1);

(c) Note by the secretariat on the 2014 UNEP Year Book (UNEP/EA.1/2/INF/2);

(d) Note by the secretariat on the Eye on Earth initiative (UNEP/EA.1/2/INF/11);

(e) Note by the secretariat on the Programme of Research on Climate Change Vulnerability, Impacts and Adaptation (PROVIA) (UNEP/EA.1/2/INF/12);

(f) Note by the secretariat on the GEMS/Water Programme: status report and pathways to the future (UNEP/EA.1/2/INF/13);

(g) Note by the secretariat on proposed procedures to enhance future assessment processes (UNEP/EA.1/2/INF/14).

3. As the principal body for the environment in the United Nations system, UNEP has a mandate to keep the global environment and causes of environmental impacts under review. UNEP operates at the science-policy interface by ensuring that knowledge flows to and from a global network of knowledge into policy action for the benefit of societies. This knowledge is sourced from relevant communities of practice, research institutions and local, indigenous and traditional knowledge holders.

4. Assessments are the building blocks for keeping the world environment under review and provide a means of enabling policymakers to reach informed decisions. These assessments should be based on relevant, reliable and timely data and information and be peer-reviewed in keeping with the principles of sound science. The temporal, thematic and spatial coverage of assessments often lacks coherence, however, in that gaps exist in the assessment landscape in parallel with overlapping assessment processes, as assessments are conducted by various stakeholders.

5. UNEP must also respond to the challenges of poverty eradication and living within sustainable limits, emerging from accelerating global megatrends. This requires improved structural and social processes as part of a modern knowledge-based society to inform integrated goal-setting and the formulation of environmental policy targets across relevant spatial and temporal scales. It will build on inclusive knowledge production and management relying on broad and flexible stakeholder participation and partnerships. UNEP will use the synergies generated by interaction between the UNEP Live web-based platform, the integrated assessment processes and the sixth report in the Global Environment Outlook series (GEO-6) to provide relevant user-driven information on sustainable development with human well-being at the centre. As environmental change has an enormous impact on sustainable development, there is a pressing need for an integrated approach to goal-setting and implementation, and environmental sustainability must be embedded in the sustainable development goals.

II. Summary of findings of assessments conducted at the global, regional and subregional levels since the twenty-seventh session of the Governing Council/Global Ministerial Environment Forum

A. Global assessments

6. The terrestrial system provides the basis for all human societies and their economic activities. People need clean air to breathe, safe water to drink, healthy food to eat, energy to produce and transport goods, and natural resources that provide the raw materials for all these services. However, the activities of the 7.06 billion people alive today (compared with a world population of only 3.85 billion in 1972)[1] are intensifying stresses on the Earth's system beyond its capacity to absorb wastes and neutralize the adverse effects on the environment. In fact, the depletion and degradation of a number of key natural resources have already constrained conventional development in some parts of the world.

7. The fifth report in the UNEP Global Environment Outlook series, GEO-5,[2] and subsequent global assessments, show environmental degradation continuing worldwide. Critical thresholds across the globe, including in specific localities, have been exceeded or are close to being exceeded. These changes have been increasingly showing serious consequences for human well-being.

1. Climate change

8. Climate change presents the global community with one of the most serious challenges to achieving development goals. The potential impacts from climate change are unlikely to be avoided on the basis of current emission reduction pledges. Despite attempts to develop low-carbon economies in a number of countries, atmospheric concentrations of greenhouse gases continue to increase to levels likely to push global temperatures beyond the internationally agreed limit of 2°C above the pre-industrial average temperature. In 2013 and 2014, the Intergovernmental Panel on Climate Change (IPCC) released three components of its Fifth Assessment Report.

9. The report of IPCC Working Group I, entitled *Climate Change 2013: The Physical Science Basis*, provides a comprehensive update of the scientific understanding of the physical science basis of climate change and represents a firm foundation for consideration of the impacts of climate change on human and natural systems and ways of meeting the climate change challenge. The report reaches the following key conclusions:

(a) Warming of the climate system is indisputable and, since the 1950s, many of the changes observed over periods ranging from decades to millenniums are without precedent. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, the sea level has risen, and the concentrations of greenhouse gases have increased;

(b) Total radiative forcing is positive, and has led to an uptake of energy by the climate system. The largest contribution to total radiative forcing is caused by the increase in the atmospheric concentration of carbon dioxide since 1750;

(c) Improved understanding of the climate system has demonstrated that these phenomena – increasing greenhouse gas concentrations in the atmosphere, positive radiative forcing and observed warming – are due to human influence;

(d) Continued emissions of greenhouse gases will cause further warming and changes in all components of the climate system. Limiting climate change can only be achieved through substantial and sustained reductions of greenhouse gas emissions.

10. The IPCC Fifth Assessment Report also showed that the land and ocean surface temperature has increased globally by nearly 1°C since 1901 (reaching a global average of 0.89°C) mainly as a result of anthropogenic activities. In parts of Africa, Asia, North America and South America, however, surface temperatures rose by as much as 2.5°C between 1901 and 2012. Urban areas have also seen heightened temperature rise, as altered storage and transfer of heat, water and airflow lead to the formation of urban heat islands. A recent study demonstrates that, although a recent slowdown in surface warming has been observed, most likely as a result of cooling of the Pacific due to

[1] See UNEP Yearbook 2013, available at www.unep.org/pdf/uyb_2013_new.pdf.

[2] Available at www.unep.org/geo/pdfs/geo5/GEO5_report_full_en.pdf.

strengthening of trade winds, rapid warming is expected once wind trends abate.[3] IPCC predicts that a global mean temperature change of between +0.3 °C and +0.7°C is likely between 2016 and 2035.

11. In 2014, two additional components of the Fifth Assessment Report were issued, namely: the IPCC Working Group II contribution, entitled *Climate Change 2014: Impacts, Adaptation and Vulnerability*, released in March 2014, in Yokohama, Japan; and the IPCC Working Group III contribution, entitled *Climate Change 2014: Mitigation of Climate Change*, released in April 2014, in Berlin. The *Synthesis Report* is to be considered in Copenhagen in October 2014.

12. The report *Climate Change 2014: Impacts, Adaptation and Vulnerability* details the impacts of climate change to date, the future risks from a changing climate, and the opportunities for effective action to reduce risks. The following are some key conclusions of the report:

(a) Observed impacts of climate change have already affected agriculture, human health, ecosystems on land and in the oceans, water supplies and people's livelihoods. The impacts are being felt from the tropics to the poles, from small islands to large continents, and from the wealthiest countries to the poorest;

(b) Responding to climate change involves making choices about risks in a changing world. The nature of the risks of climate change is increasingly clear, though climate change will also continue to produce surprises;

(c) Adaptation in order to reduce the risks from a changing climate is now starting to occur, but with a stronger focus on reacting to past events than on preparing for a changing future;

(d) Future risks from a changing climate depend strongly on the level of future climate change. Increasing magnitudes of warming will also increase the likelihood of severe and pervasive impacts that may be surprising or irreversible.

13. The summary for policymakers of the Working Group III contribution to the Fifth Assessment Report was approved and its underlying scientific/technical assessment was accepted by member Governments at the twelfth session of the Working Group, held in Berlin from 7 to 11 April 2014. Working Group III concluded that:

(a) The concentration of greenhouse gases grew more quickly during the last decade than in each of the previous three decades. Carbon dioxide emissions from fossil fuel combustion and industrial processes contributed about 78 per cent of the total greenhouse gas emission increase from 1970 to 2010, with a similar percentage contribution for the period 2000–2010. Without additional efforts to reduce such emissions beyond those in place today, emissions growth is expected to persist, driven by growth in global population and economic activities;

(b) Mitigation scenarios in which it is likely that the temperature change caused by anthropogenic greenhouse gas emissions can be kept to less than 2°Celsius relative to pre-industrial levels are characterized by atmospheric concentrations of greenhouse gases in 2100 of about 450 parts per million carbon dioxide equivalent;

(c) To have a good chance of limiting the increase in global mean temperature to 2°C in this century will require that global greenhouse gas emissions be lowered by 40–70 per cent from 2010 levels by mid-century and to near-zero gigatons of carbon dioxide equivalent, or even lower, by the end of the century;

(d) Delaying mitigation efforts beyond those in place today through 2030 will probably increase substantially the difficulty of moving to low emissions levels in the long term and to narrow the range of options for maintaining temperature change below 2°C.

14. The Emissions Gap Report, an annual assessment of the adequacy of pledges by parties to the United Nations Framework Convention on Climate Change to keep the world on track to meet the 2°C target, is coordinated by UNEP and released as negotiators prepare to meet for the Conference of the Parties. The assessment is based on a host of new studies and brings new light to bear on the consequences of inaction. The *Emissions Gap Report 2013* was launched in Berlin and four other cities around the world on 5 November 2013.[4] It was also presented to parties to the Framework Convention at two side events held during the nineteenth session of the Conference of the Parties, held in Warsaw from 11 to 22 November 2013.

[3] Matthew H. England and others, "Recent intensification of wind-driven circulation in the Pacific and the ongoing warming hiatus", *Nature Climate Change*, vol. 4, pp. 222–227 (2014).

[4] Beijing, Brussels, Rio de Janeiro and Washington, D.C.

15. The report[5] estimates current global emissions at around 50 gigatons per year of equivalent carbon dioxide, which is substantially higher than the emissions level in 2020 should be if the 2°C climate target is to be met. If all pledges are fully implemented, the emissions gap in 2020 is estimated at between 8 and 12 gigatons of carbon dioxide equivalent. The report indicates, however, that this gap can closed by a combination of actions within the Climate Convention and by stronger national and international measures, including by promoting sustainable agriculture practices, building rapid transit bus systems, legislating appliance standards and promoting international cooperative initiatives, aimed, for example, at energy efficiency, fossil fuel subsidy reform and the reduction of methane and other short-lived climate pollutants. The report also highlights the consequences of not closing the gap in 2020, which include the higher cost and greater lock-in of carbon intensive infrastructure, greater risks of economic disruption and greater risk of failing to meet the 2°C target.

16. The initial findings of the UNEP synthesis report on nitrous oxide, entitled *Drawing Down N_2O to Protect Climate and the Ozone Layer*, were presented at a side event on 24 October 2013 at the Twenty-Fifth Meeting of the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer in Bangkok, and the full report was launched on 21 November 2013 at the nineteenth session of the Framework Convention on Climate Change in Warsaw. The report, which is aimed at informing policymakers and stakeholders about the impacts of nitrous oxide emissions on climate and the ozone layer and to present available opportunities for reducing emissions, shows that the continued build-up of nitrous oxide in the atmosphere will make it more difficult to achieve climate targets and will to a certain extent undermine the achievements of the Montreal Protocol in restoring the ozone layer. At the same time, however, it shows that nitrous oxide emissions can be reduced by boosting nitrogen use efficiency in the agricultural sector (making more efficient use of fertilizer, manure, and feed), installing nitrous oxide abatement technologies in nitric and adipic acid facilities in the industrial sector, reducing biomass burning, improving the fuel and combustion efficiency of household stoves, by improving the collection and treatment of wastewater and by other measures in aquaculture processes.

17. According to the report,[6] reducing emissions of nitrous oxide would not only produce benefits for climate and the ozone layer, but would also bring the added benefits of higher agricultural productivity, lower required agricultural inputs and a reduction in the air and water pollution associated with the release of excess nitrogen into the environment.

18. On 9 May 2013, the daily mean concentration of atmospheric carbon dioxide exceeded 400 parts per million (ppm) – the highest recorded level since measurements began at Mauna Loa Observatory in Hawaii, United States of America, in 1958. Since then, seasonally corrected monthly mean concentrations of carbon dioxide have continued to rise.

19. Application of current low-carbon technologies and existing policy options would reduce the risks posed by climate change but, ultimately, a transformation in the way energy is produced and the efficiency with which energy and other resources are used, coupled with a shift in consumption and production patterns and investment in innovation, will be required to achieve long-term climate goals.

2. Energy

20. Today, renewable energy production accounts for approximately 13 per cent of the global primary energy demand. Despite an overall decline in clean energy investments for 2013,[7] total installed capacity of solar photovoltaic energy increased by 43 per cent in 2013, according to the International Energy Agency's 2013 report,[8] and the share of renewables in primary energy use is predicted to rise to 18 per cent in 2035. The Agency reports that global bioenergy resources are more than sufficient to meet projected demand without competing with food production but cautions that managing the required land-use and implications for biodiversity will require careful planning.

3. Disasters

21. Since the start of the new millennium, 47 major conflicts and a total of 2,678 disasters have affected millions of people around the world.[9] These crises have destroyed infrastructure, displaced entire populations and threatened the ecosystems that support the lives of many. The impacts of these

[5] The main messages, findings and response options contained in the report are available at the following link: www.unep.org/publications/ebooks/emissionsgapreport2013.

[6] The main messages, findings and response options contained in the report are available at the following link: www.unep.org/publications/ebooks/UNEPN2Oreport.

[7] See www.unep.org/pdf/GTR-UNEP-FS-BNEF2.pdf.

[8] See chapter 6 of the World Energy Outlook 2013 at www.worldenergyoutlook.org/publications/weo-2013.

[9] See EM-DAT: the OFDA/CRED International Disaster Database at www.emdat.be/database.

crises have been disproportionately borne by the most vulnerable sectors of society, affecting livelihoods and compounding poverty.

22. Early in 2014, a number of countries have been affected by extreme weather events. The Plurinational State of Bolivia and the United Kingdom of Great Britain and Northern Ireland have experienced severe flooding, which has caused infrastructure damage and the displacement of people. Heavy snowstorms and unusually low temperatures have hit Japan and the United States of America, with cold fronts reaching much lower latitudes.

4. Ecosystems

23. The current trends in the state of our ecosystems are undermining our ability to tackle poverty, improve the health, prosperity and security of our populations, and deal with climate change, and each of these will be greatly strengthened if we correctly value the role of biodiversity in supporting the shared priorities of the international community. We can no longer see the continued loss of and changes to biodiversity as an issue separate from the core concerns of society. Substantial loss of biodiversity and the degradation and over-exploitation of habitats have already affected the provision of ecosystem functions and services, such as water regulation, and have led to the collapse of a number of fisheries. According to the fifth report in the Global Environment Outlook series (GEO-5) the number of eutrophic coastal areas has increased dramatically since 1990 – at least 415 coastal areas have exhibited serious eutrophication and only 13 of these are recovering.

24. The current trends in economic development are based on unsustainable linear economic growth, which has come at the expense of equity, natural resources and ecosystems. Many terrestrial ecosystems are being severely degraded because of the lack of proper long-term policies that address land-use decisions. Development measures often fail to recognize non-economic ecosystem functions that limit productivity and long-term ecosystem sustainability. For example, short-term financial pressures have encouraged the irrigation and subsequent salinization of vast dryland areas, making them very costly to rehabilitate for the present and future populations. Deforestation and forest degradation produce financially attractive short-term profits, but estimates prepared under the Economics of Ecosystems and Biodiversity initiative (TEEB), based on alternative accounting methods, suggest that they are costing the global economy between $2 trillion and $4.5 trillion a year[10] – more than the losses of the 2008 economic crisis.

5. Forests

25. While the rate of forest loss is slowing, it remains alarmingly high with annual forest lost, between 2000 and 2010, measured at approximately 13 million hectares.[11] A recent global mapping of forest cover[12] reports a loss of 2.3 million square kilometres and gain of only 0.8 million square kilometres from 2000 to 2012, with the tropics experiencing the greatest total loss, of 2101 square kilometres per year. Heightened interest in carbon sequestration has inspired new incentives and financing for ecosystem protection. One such opportunity – the mechanism to reduce emissions from deforestation and forest degradation in developing countries (REDD) – has emerged as an important component of a global strategy to reduce emissions while generating financial flows from North to South.

6. Food security and land

26. Food insecurity and land degradation will intensify unless increasing pressures and competing demands on land are wisely managed. Meeting this challenge will require the adoption of new economic paradigms that explicitly factor in the environment. Options leading towards a green economy[13] represent one such approach, which includes the principles: valuation of natural resources and environmental assets; pricing policies and regulatory mechanisms that translate these values into market and non-market incentives; and measures of economic welfare growth that are responsive to use, degradation, and loss of ecosystem goods and services. The 2013 publication entitled *Smallholders, Food Security, and the Environment*[14] reports that supporting smallholder farmers to play a greater role in food production and natural resource stewardship offers one of the quickest ways of lifting over 1 billion people out of poverty and sustainably nourishing a growing world population.

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[10] For example, see www.unep.org/pdf/OP_sept/2010/EN/OP-2010-09-EN-FULLVERSION.pdf.

[11] See www.fao.org/docrep/013/i1757e/i1757e.pdf.

[12] See www.sciencemag.org/content/342/6160/850.

[13] See the UNEP green economy initiatives (GEI) at www.unep.org/greeneconomy.

[14] See www.unep.org/greeneconomy.

27. The 2014 report of the International Resource Panel, entitled *Assessing Global Land Use: Balancing Consumption with Sustainable Supply*,[15] points out that up to 849 million hectares of natural land – nearly the size of Brazil – may be degraded by 2050 should current trends of unsustainable land use continue. As much as 319 million hectares of land can be saved by 2050, if the world follows a combination of measures designed to keep cropland expansion within the so-called "safe operating space" that include improving land management and land-use planning in order to minimize the expansion of built-up land on fertile soils, improving agricultural production practices to increase intensification in an ecologically and socially acceptable way, improving efficiency along the whole food chain by increasing crop yields through research and extension, and reducing food waste and spoilage by improving the transport, storage and distribution infrastructure in developing countries and by changing behaviour in wealthier societies where much food waste occurs and where a shift towards more vegetable-heavy diets will also be crucial to improving food security. It will also be necessary to reduce the subsidization of fuel crops – including the reduction and phase-out of biofuel quotas in consuming countries.

28. The report also explores how the management of land-based biomass production and consumption can be elevated towards a higher degree of sustainability across different scales: from the sustainable management of soils in the field to the sustainable management of global land use as a whole. A central question posed by the authors is to what extent global cropland can expand to serve the growing demand for food and non-food biomass, while keeping the consequences of land-use change, such as losses of biodiversity, at a tolerable level. Over the last five decades, the area used for agriculture has been expanding at the expense of forests, in particular in tropical regions. On average, 13 million hectares per year have been deforested, with significant impacts on biodiversity as well. Around 23 per cent of global soils are estimated to have been degraded. The current trends of cropland expansion, land degradation, yield stagnation, nutrient pollution and large-scale land acquisition show the urgent need to improve the management of land resources. Measures to improve productivity will not be enough to maintain sustainable levels of land use in the future but the combination of consumption-oriented measures with improved land management and restoration of degraded land may enable us to save between 161 and 319 million hectares of land by 2050.

7. Fresh water

29. Up to 90 per cent of all wastewater in developing countries flows untreated into rivers, lakes and highly productive coastal zones, threatening health, food security and access to safe drinking and bathing water.[16] The cumulative impacts of excessive, illegal or unregulated wastewater discharges are particularly damaging to coastal areas, since these contain some of the world's most productive yet fragile ecosystems. The pace of increasing demands on freshwater and ocean resources must be matched by improved governance. The open oceans are a major global commons and require effective international cooperation and governance. Most human and environmental water problems result from inadequate governance involving policy, institutional, financial and stakeholder issues. Integrated management approaches to these constraints require time and resources if they are to succeed. They need the enhanced integration of policies and institutions between sectors and governance levels, implementation and enforcement of relevant agreements and goals, and improved monitoring and resolution of transboundary issues. Good governance, including stakeholder and private sector participation and gender considerations, is critical to increasing social and environmental resilience and sustainability.

8. Coastal and marine resources

30. The many challenges facing coral reefs were highlighted in the 2012 UNEP Foresight Process on emerging environmental issues for the twenty-first century. One fifth of the world's coral reefs have been lost, and more than 60 per cent are under immediate and direct threat from over-harvesting, pollution arising from land-based activities, including nutrients, sediments, and sewage, and physical alteration and destruction of habitat as a result of poorly managed coastal development.[17] Invasive alien species constitute a further grave threat, as illustrated by the introduction of Indo-Pacific lionfish

[15] See www.unep.org/resourcepanel/Portals/24102/PDFs//Full_Report-Assessing_Global_Land_UseEnglish_(PDF).pdf.

[16] See www.unep.org/pdf/SickWater_screen.pdf.

[17] C. Wilkinson (ed.) (2008), *Status of Coral Reefs of the World 2008*, available at http://gcrmn.org/?post_type=gcrmn-publication&p=153; Burke and others (2011), *Reefs at Risk Revisited*, available at www.wri.org/publication/reefs-risk-revisited.

to the Caribbean.[18] This undermines the integrity and service provision of coral reefs and threatens food security, the health and well-being of coastal people, and the economies of many countries. It also reduces the ability to withstand and adapt to increasing climate change. Repeated coral bleaching (a stress response caused by above-average sea surface temperatures that can lead to mortality) has been recorded in most regions since the mass mortality in 1998. While strong recovery has been seen in some areas where direct stress is low,[19] recovery is stalled or weak where there are substantial human pressures.

31. Evidence is also beginning to emerge of coral sensitivity to ocean acidification, with decline in coral calcification rates and potentially significant ecological and economic implications. Recent detailed analysis of long-term coral reef data in the Caribbean[20] shows that, while Caribbean live coral cover overall has seen drastic decline in the past 40 years, there is enormous variability among reef locations. Coral abundance today is strongly correlated with the history of overfishing and abundance of the sea urchin *Diadema antillarum* prior to its mass mortality in 1983–1984, whereas the correlation with the incidence of hurricanes or outbreaks of coral bleaching and disease is weaker. This provides further evidence that ecosystem management has a significant impact on the condition of coral reefs during climate change too. Ensuring the continued provision of coral reef ecosystem services requires ecosystem-based management that addresses multiple threats in an integrated manner and builds resilience in the face of climate change, including through the enhanced policy application of assessments of coral reef status and trends and also through ecosystem service values.

32. The largest ever under-ice algal bloom was recorded in the Arctic in 2012 by the National Aeronautics and Space Administration (NASA) of the United States of America, under its multi-year ship-borne project on the impacts of climate on the ecosystems and chemistry of the Arctic Pacific environment (ICESCAPE). Since then many other related phenomena have been observed.[21] The key driver of under-ice algal blooms is thought to be climate change, via its impact on the thinning of sea ice and surface meltwater, which allows higher light penetration into under-ice waters, leading to much greater phytoplankton densities than expected. Changes in river discharge patterns and the concentration of nutrients entering Arctic waters from land are also likely to reinforce this phenomenon in future, in particular in coastal areas. Although the effects of algal blooms on Arctic ecosystems are yet to be studied in detail, food chains involving migratory species of mammals, birds and fish, together with species affected by oxygen conditions on the sea bottom, are likely to change. Decreases in the extent and thickness of sea ice are thought to be an driving force behind marine and terrestrial ecological dynamics, influencing productivity, species interactions, population mixing, gene flow and pathogen and disease transmission.

33. UNEP, as part of its function as secretariat for the Global Partnership on Marine Litter, has been paying particular attention to the emerging issue of microplastics. Plastic debris may enter the ocean directly, or it may find its way there via other water bodies or the atmosphere. The key to stemming flows of plastic debris into the ocean is to prevent this debris entering the environment. Based on the limited data available, there appears to have been a significant increase in concentrations of microplastics in surface waters of the ocean over the past four decades. A large number of plastic materials are currently being applied in personal care and cosmetic products for a variety of purposes. They tend not to be filtered out during sewage treatment, but released directly into the ocean or other water bodies such as lakes and rivers.

34. Across the world, recent scientific meta-analyses of carbon sequestration and storage in coastal ecosystems have estimated that carbon dioxide emissions from the degradation and clearing of coastal ecosystems are significant. Between some 0.15 and 1.02 Pg (billion tons) of carbon dioxide are being

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[18] Gómez Lozano and others (2012), *Regional Strategy for the Control of Invasive Lionfish in the Wider Caribbean*, available from www.icriforum.org/icri-documents/icri-publications-reports-and-posters/lionfish_strategy

[19] C. Wilkinson (ed.) (2008), *Status of Coral Reefs of the World 2008*, available at http://gcrmn.org/?post_type=gcrmn-publication&p=153; Burke and others (2011), *Reefs at Risk Revisited*, available at www.wri.org/publication/reefs-risk-revisited.

[20] Jackson and others, *Status and Trends of Caribbean Coral Reefs 1969–2012* (Global Coral Reef Monitoring Network (GCRMN), International Union for Conservation of Nature (IUCN), International Coral Reef Initiative (ICRI), UNEP) (in press).

[21] See "Massive phytoplankton blooms under Arctic sea ice" (DOI: 10.1126/science.1215065, Arrigo and others, 2012); "Ecological consequences of sea-ice decline" (DOI: 10.1126/science.1235225, Post and others, 2013); "Export of algal biomass from the melting Arctic sea ice" (DOI: 10.1126/science.1231346, Boetius and others, 2013).

released annually, equivalent to 3–19 per cent of those from deforestation globally, and these result in economic damage costing between $6 billion and $42 billion annually.[22]

9. Chemicals

35. The way in which the world manages chemicals will play a key role in the transition to an inclusive green economy and the realization of a sustainable twenty-first century. The *2013 Global Chemicals Outlook*[23] draws attention to the increasing production and consumption of chemicals currently occurring in developing countries and countries with economies in transition. Detailed data on waste are lacking because of the absence of pollution release and transfer registries in developing and transition countries. The increasing production, use and disposal of chemicals have significant implications for the environment and human health. Effects on ecosystem resources include the contamination of air, water, and soil, with adverse impacts on food sources and wildlife, together with human health effects. In this context, it is necessary to consider policy approaches to ensure that chemicals are produced and used in ways that minimize impacts on health and the environment. Failure to adopt sound chemicals management can entail massive economic costs and, conversely, sound chemicals management can yield significant economic benefits in terms of economic development, poverty reduction and, crucially, reduced risks to human health and the environment.

36. Effective management of these issues can be achieved by further promoting synergies among multilateral environmental agreements in terms of administrative, logistical and programme integration; strengthening international and national chemical control activities, including through legislation to address gaps in the current chemicals-related multilateral environmental agreements; mainstreaming sound chemicals management into multilateral and bilateral economic assistance programmes; and fostering public-private partnerships to promote the implementation of sound chemical management policies and strategies as a contribution to economic development plans and processes.

10. Resource efficiency

37. The global use of natural resource materials increased by over 40 per cent between 1992 and 2005, from about 42 billion to nearly 60 billion tons.[24] On a per capita basis, this represented an increase of 27 per cent. Among the four major material groups (biomass, fossil fuels, ores and industrial minerals, and construction minerals) there has been a major increase – some 80 per cent – in the extraction of construction minerals, followed by an increase of close to 60 per cent in that of ores and industrial minerals. The global primary production of metals accounts for a large share, measuring between 7 and 8 per cent, of the world's total energy use and causes severe local environmental impacts. A continued global rise in metals demand is currently predicted for the decades ahead, as a consequence of urbanization and the building of infrastructure in developing countries that will further increase the environmental impacts of metal production.[25] What economies worldwide need is the absolute decoupling of the environmental pressure associated with resource consumption from economic growth. This will be easier to achieve to the extent that resource use itself becomes more efficient.

11. Nutrients

38. In 2013, the Global Partnership on Nutrient Management released a global overview of nutrient management entitled *Our Nutrient World: The challenge to produce more food and energy with less pollution.*[26] The overview highlights the manner in which humans have massively altered the natural flows of nitrogen, phosphorus and other nutrients and caused a web of water and air pollution that is damaging human health, causing toxic algal blooms, killing fish, threatening sensitive ecosystems and contributing to climate change. Since the 1960s, human use of synthetic nitrogen fertilizers has increased ninefold globally, while phosphorus use has tripled. A further substantial increase, of between 40 and 50 per cent, is expected over the next 40 years, driven by the need to feed the growing world population and by current trends in dietary lifestyles, with the increasing consumption of animal products. These changes will exacerbate current environmental problems

[22] Pendleton and others, "Estimating global 'blue carbon' emissions from conversion and degradation of vegetated coastal ecosystems", PLoS ONE; vol. 7, issue 9, September 2012.

[23] See http://www.unep.org/chemicalsandwaste/Portals/9/Mainstreaming/GCO/The%20Global%20Chemical%20Outlook_Full%20report_15Feb2013.pdf.

[24] www.unep.org/geo/pdfs/keeping_track.pdf.

[25] See the 2013 International Resource Panel (IRP) report, available at www.unep.org/resourcepanel/Publications/EnvironmentalChallengesMetals/tabid/106142/Default.aspx.

[26] www.gpa.unep.org/index.php/global-partnership-on-nutrient-management/publications-and-resources/global-partnership-on-nutrient-management-gpnm/143-our-nutrient-world.

unless urgent action is taken to improve the efficiency of nitrogen and phosphorus use and to re-evaluate future per capita food consumption patterns.

39. The efficiency of nutrient use is very low. On average, over 80 per cent of the nitrogen and between 25 and 75 per cent of the phosphorus consumed end up being lost into the environment, wasting the energy used to prepare them and causing pollution through emissions of the greenhouse gases nitrous oxide and ammonia into the atmosphere, plus losses of nitrate, phosphate and organic nitrogen and phosphorus compounds into water. A 20 per cent improvement in nutrient use efficiency by 2020 would reduce the annual use of nitrogen fertilizer by 20 million tons, which could provide a net saving of around £110 billion (approximately $200 billion) per year.

40. There is an urgent need to develop joined-up approaches that optimize the planet's nutrient cycles for delivery of our food and energy needs, while reducing threats to social and economic wellbeing, including threats to climate, ecosystem services and human health. This set of multiple connections may be termed the "nutrient nexus", where good nutrient management can be seen as making a vital contribution to all global change challenges. The consequences of not taking action include further global warming effects from increasing atmospheric nitrous oxide (a greenhouse gas which, in terms of radioactive effect, is 300 times more reactive than carbon dioxide), the continuing deterioration of water, air and soil quality, the shortening of human life, and threats to ecosystem services and biodiversity. The full damage cost has not yet been assessed, but the annual global loss of ecosystem services, including damage to fisheries from coastal nitrogen and phosphorus pollution-related hypoxia, alone costs an estimated $170 billion. Making better use of nutrients will reduce these pollution threats, while improving food and energy production.

B. Regional assessments

41. Assessments conducted at the regional level are usually carried out in response to the mandates imposed by regional forums such as the African Ministerial Conference on the Environment (AMCEN) or the Council of Arab Ministers Responsible for the Environment (CAMRE). In addition to addressing regional issues, the findings of such assessments also support global assessment processes. The assessment cycle for regional assessments can vary from three years (Africa) to five years (Europe). Some regional and subregional assessments, however, are carried out on a one-off basis.

1. Africa

42. The third report in the Africa Environment Outlook series (AEO-3)[27] was launched on 17 October 2013 during the fifth special session of AMCEN. The report reveals that 28 per cent of Africa's disease burden is directly related to the decline in environmental integrity. Diarrhoea, respiratory infections, and malaria account for 60 per cent of all known environmentally related diseases in the region. AEO-3 draws on the latest data available on air quality, biodiversity, chemicals and waste, climate change, freshwater and sanitation and land, while emphasizing the need to update existing data on linkages between health and the environment in Africa.

43. The report *Adaptation to Climate-Change Induced Water Stress in the Nile Basin: A Vulnerability Assessment Report*[28] was launched on 4 September 2013 in Stockholm, during World Water Week. Climate change-induced water stress is a growing concern in the Nile basin, which provides vital resources to 238 million people in 11 countries, but risks can be reduced through building adaptation strategies into development policy, boosting transboundary cooperation and improving available data on future water availability.

2. Asia and the Pacific

44. The report entitled *Recent Trends in Material Flows and Resource Productivity in Asia and the Pacific*[29] was released on 24 April 2013 at the Asian and Pacific regional implementation meeting on the outcomes of the United Nations Conference on Sustainable Development, as a special contribution to the regional deliberations of its follow-up actions to the Conference. The report covers the period including the onset of the global financial crisis, and concludes that the Asian and Pacific region has surpassed the rest of the world in its consumption of materials and will continue to dominate world material flows. The region's trade balance indicates that the current rate of exploitation of its resource base is no longer sufficient to support the region's fast-growing economies and changing lifestyles.

[27] The main messages, findings and response options contained in the report are available at the following link: www.unep.org/pdf/aeo3.pdf.

[28] The main messages, findings and response options contained in the report are available at the following link: www.unep.org/dewa/Portals/67/pdf/Nile_Basin.pdf.

[29] See www.unep.org/pdf/RecentTrendsAP(FinalFeb2013).pdf.

Over the period from 1970 to 2008, the consumption of construction minerals increased 13.4 times, that of metal ores and industrial minerals 8.6 times, that of fossil fuels 5.4 times, and that of biomass 2.7 times. The data indicate that, at this rate, the region will be increasingly dependent on imports and unable to sustain its economies and lifestyles. The report emphasizes that the Asian and Pacific region still has ample opportunity to effect a transition of its current economic growth patterns towards green growth, and to transform its economies into truly green economies, despite the greater challenges faced by member countries.

45. Under the auspices of the South Asian Association for Regional Cooperation, UNEP collaborated with regional institutions and member countries to develop the South Asia Environment Outlook for 2013 and 2014. The South Asia subregion encompasses eight countries: Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. The report undertakes to analyse environmental challenges and priorities in the context of human development and economic growth issues at both regional and national levels. It will also review the interlinkages between environmental priorities, such as climate change, land degradation, air and water pollution and the loss of biodiversity, and the drivers of environmental change such as urbanization, economic growth and unsustainable consumption. Various policy and institutional options catering to the emerging challenges of the subregion will be developed.

3. Europe

46. The report entitled *Resource Efficiency: Economics and Outlook for Eastern Europe, the Caucasus and Central Asia*, one of a series of UNEP studies following a similar analytic methodology, to be released in 2014, will provide a deeper understanding of the underlying causes of resource efficiency issues in this large and rapidly evolving region. The report will provide a detailed analysis of material flows and resource efficiency at both the country and the regional levels; a close examination of water use and efficiency in the region; and finally, an analysis of policies relating to natural resource management and use across the region.

4. Latin America and the Caribbean

47. The report entitled *Recent Trends in Material Flows and Resource Productivity for Latin America*,[30] published by UNEP and the Commonwealth Scientific and Industrial Research Organization (CSIRO), uses standardized material flow accounting methodologies to construct empirical evidence of resource productivity in 10 focus countries in Latin America. The report is based on the database of material flows created to cover the larger countries of Latin America and the Caribbean.[31] Among other findings, the report provides evidence that resource efficiency (as measured by raw materials extracted per unit of GDP) has declined in the region since 1970, largely because of a massive increase in extractive industries, much of which is destined for export.

5. West Asia

48. The *Arab Region Atlas of Our Changing Environment*[32] was launched in Abu Dhabi on 10 December 2013. The atlas examines the environmental changes that have taken place at more than 80 locations across the Arab region, using a combination of on-the-ground photographs and current and historical satellite images, with a narrative based on extensive scientific evidence. "Before-and-after" studies in the atlas clearly demonstrate the pace of development in the region, offering compelling examples of wide-ranging environmental change, including land-use change, urban growth, the degradation of marine and coastal areas, altered hydrology and shrinking water bodies, the loss of habitats and impacts of climate change.

49. The *Arab Millennium Ecosystem Assessment: Synthesis Report* was launched on 7 November 2013 in Cairo. The report represents a synthesis of the findings of the three Millennium Ecosystem subglobal assessments for the Arab region and highlights the commonalities and differences between the sites and the manner in which they relate to the national, regional and global ecosystems. The report indicates that ecosystems in the Arab region are subject to rapid depletion, posing a significant challenge to the sustainability of future generations. The common ecosystem services in the three assessments include water, agriculture, the grazing and raising of cattle, the cultivation of aromatic and medicinal plants, and biodiversity. Achieving the sustainable management of ecosystems requires a number of interventions, including the sustainable use of ecosystems, empowering human capital and providing leadership, institutional reform, and innovation through knowledge sharing, reshaping

[30] Available at: www.pnuma.org/english/comunicados/2013/20130619/index.php.

[31] Available at: www.ces.csiro.au/forms/form-mf-la-start.aspx.

[32] See http://na.unep.net/atlas/viewAtlasBookWithID.php?atlasID=2447.

traditional approaches, progressive environmental governance, creative solutions, and the sharing of best practices.

50. The report entitled *Vulnerability Assessment of Freshwater Resources to Climate Change: Implications for Shared Water Resources in the West Asia Region*,[33] an assessment prepared in cooperation with the Arabian Gulf University, the Arab Centre for the Study of Arid Zones and Dry Lands (ACSAD), and the Centre for Environment and Development for the Arab Region and Europe (CEDARE). The assessment provides a better understanding of the vulnerability of freshwater resources to threats and the impact of this vulnerability on development options, human well-being and the environment. It identifies the potential impacts of climate change on water resources in the region and assesses the current adaptive capacity of the water sector. It also provides decision makers with strategic responses and policy options to improve water resource management, including adaptation measures. Water stress in West Asia is expected to deepen under the impact of climate change and will remain a major constraint to social and economic development. Understanding the vulnerability of water systems in West Asia, therefore, is vital for sustainable water resource management in the region. The assessment concludes that political action is needed to ensure the sustainable management of water resources, with vulnerability and adaptation to climate change integrated into future national plans. It recommends that resource management policies shift to demand management, water-use efficiency and conservation.

51. A comprehensive scientific assessment of coastal ecosystem carbon and ecosystem services values in Abu Dhabi was carried out under the special initiative on oceans and blue carbon, adopted by the Eye on Earth Summit in Abu Dhabi in December 2011. This was the first time that an assessment of this type had been carried out in the region, and the scientific findings show that Abu Dhabi's coastal ecosystems store significant amounts of carbon that would be emitted if they are degraded. Carbon stocks in coastal ecosystems are the largest of any ecosystem in the Emirate, although on a global scale they are at the low end of the spectrum. Wider ecosystem services, including shoreline buffering, erosion control, water quality maintenance, support to fisheries, tourism and recreation, were found to be more valuable at local scales than carbon, with cultural values attached to mangroves being especially high.[34]

III. Early warning of environmental threats and emerging issues

52. The UNEP mechanism for identifying, selecting and communicating early warning information on emerging issues to decision makers across the UNEP focus areas, the Global Environmental Alert Service (GEAS), focuses on identifying and communicating emerging environmental issues to raise public awareness. GEAS takes the pulse of the planet and enhances the ability of UNEP to provide regular, science-based updates to its member States, allowing them to make informed policy choices against expected adverse impacts on the well-being of people and on the services that different ecosystems provide. It continuously scans the scientific literature and analyses the results of earth observations and other data sources to produce easily understandable alerts, focusing on policy-relevant environmental hotspots, environmental science, and near real-time environmental hazards. GEAS communicates the emerging scientific findings on the status and trends of the global environment in an appropriate and accessible way to policymakers, the international community, humanitarian groups, civil society and the media.

53. The global readership of GEAS has grown significantly, as demonstrated by an increase in the number of web visits and the download statistics. Circulated every month to a list of over 500,000 users globally, GEAS bulletins include new visual evidence of global environmental change resulting from natural processes and human activities and the interaction between them.[35] The GEAS change studies are described and analysed through photographs, satellite images, maps and narratives that provide an insight into the many ways and places in which the environment has changed and continues to be modified. GEAS has been referenced in scientific journal articles and newspapers and its materials are regularly published in the journal *Environmental Development*.

54. UNEP will provide the global community with access to dynamic, compelling, easy-to-understand and policy-relevant information about environmental changes as they occur, with the goal of mitigating environmental harm through e-books and near-real-time data and information updates.

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[33] See http://www.unep.org/dewa/Portals/67/pdf/Freshwater_vunerability_Report_HR.pdf.

[34] See http://grida.no/publications/abu-dhabi-blue-carbon.

[35] Titles of recent bulletins and response actions may be found at http://na.unep.net/geas/index.php.

55. Emerging environment issues have been brought to the attention of decision makers on a regular basis through the UNEP Year Book series, on emerging issues in the global environment. A decade ago, UNEP launched the Year Book series, with a focus on the issue of excess nitrogen and dead zones in the 2003 report. Today, the tenth edition, the *UNEP Year Book 2014*, takes the form of a special anniversary edition, revisiting key emerging environmental issues that were highlighted in the series over the past decade. These include such topics as excess nitrogen, emerging infectious diseases, plastic debris in the ocean, and rapid change in the Arctic. For each topic, a succinct synopsis of the situation is provided, followed by an overview of new scientific evidence and key developments since the issue was published by UNEP. Examples of successful efforts by stakeholders are given, directly highlighting the work of partners, and options for actions are presented for consideration by decision makers. To embrace the opportunities provided by new technology and by the launch of the UNEP web-based platform UNEP Live to reach much wider audiences, the UNEP Year Book 2014 has been prepared as an e-book and in a web-based form, and includes videos explaining the issues, interactive graphs showing trends, interviews with experts and live links to data sources, articles and relevant knowledge providers. The overall findings show that, in many cases, issues from the past persist today despite better scientific understanding and a multitude of actions undertaken by various stakeholders in response to them.

IV. Conclusion

56. As the international community lays the foundations for a post-2015 sustainable development agenda, there is abundant evidence that the Earth's systems are changing, moving us closer to alarming thresholds. Environmental degradation and widespread changes resulting from human activity, combined with natural processes and the loss of ecosystem services, constitute barriers to the attainment of internationally agreed development goals.

57. The scientific community is being asked to synthesize the latest information on environmental systems in order to respond to a growing number of key environmental challenges facing society at large on all scales, from global to local, arising from a changing Earth system. The knowledge gathered by UNEP, based on data and information on broad geographical and temporal scales, now needs to be processed through the prism of a variety of scientific disciplines. The goal set before policymakers now is to use this knowledge in a dynamic, multidirectional, scientific, social and economic policy process, to inform people about the risks, opportunities and choices that exist, rather than to advocate any particular management solution.